SUPPLEMENT.

The Mining Journal,

[R]AILWAY AND COMMERCIAL GAZETTE:

FORMING A COMPLETE RECORD OF THE PROCEEDINGS OF ALL PUBLIC COMPANIES.

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Original Correspondence.

NOTES ON CONTINENTAL MINING—No I.

ECONOMIC GEOLOGY OF BELGIUM.

1839 a new kingdom was added to the map of Europe. Smallest ...koned by square miles (11,375), and most populous (383 to each ..., it is one of the richest of European States in mineral wealth, ...specially in coal. Though possessing only 900 square miles ...al field this county raises more coal than France—nearly 14,000 annually per square mile of coal field.

...taking a rapid glance at the geological features of this country, ...especial reference to the utilisation of its mineral wealth, it ...e necessary, in the first instance, to waive consideration of the ...tic rocks, which only make their appearance in small upthrows, ...egard the slate series as the base of the Belgian measures. The ...y is geologically in two divisions—the south part forms an ...se double basin of slate rocks. These two hollows are filled ...h the older secondary rocks and coal measures, and constitute ...ineral districts of Belgium. To the north the slate slopes away, ...d by the Cretaceous and Tertiary beds. This slate series, in ... we may trace three separate beds, is employed in the Ardennes ...t for rough walling, and even, in the rural parts, for building ...king like the slate-built houses of Wales and Cumberland. Its application, however, is for roofing, and for this purpose it is ...y exported into Holland. The most famous quarries are within ...rench frontier, at Fumay and Rimsgue; and in Belgium, at ...umont and Viel Salm.

...en the slate lies close to the surface, it seems to have suffered ...position through atmospheric influences, though it is a re...ble fact that the deeper slates exposed to the air now are ex...gly unalterable, and the same is the case also where the slate ...out in bluffs or escarpments. Portions of magnetic iron ore ...und in the slate, and also plumbago, which in some parts has ...kened the rocks as to induce more than one attempt to sink ...al. At Houffalize there is a tolerable trade in whetstones, and ...r south numerous veins of quartz traversing the slate are used ... porcelain manufactories and the glass works. The mineral ...of these rocks are not very persistent, the lode often expand...o a bunch, and then dying away to a thread, or even ceasing ...ther, making the prosecution of the veins very uncertain and ...dous. The chief mineral sought is galena. Near Bastogne ...lphide of lead contains antimony in paying quantities. Car... of lead and blende are also found near the surface, and often ...menting each other. Other minerals are copper pyrites, mala... manganese, and iron. This latter ore is in the state of proto...r oxide, and appears to be derived from decomposed slaty ...in a manner analogous to the recently-discovered iron ores in ...salt of Antrim. In this huge double basin of slate rocks, occu...nearly the whole of the country south of Brussels, we find a ... of Devonian rocks. This measure is composed principally ...stone, schist, and a conglomerate or pudding-stone. These ...formably on the slate in the two main hollows, which we may ...e Namur basin and the Denant basin, and present four lines ...rop—that is, two at the opposite sides of each basin, the two ...nesclose together. Some portions of this series make excellent ...ne for building, while in other parts the lime is indurated ... has the appearance of marble, and is sold for ornamental ...es, under the name of little granite *(petit granite)*. Large ...ties of lime are burnt for building, and always by coal, even ...wood is cheaper. The limeburners have an idea that to burn ...al is essential to the production of a good quality of lime. In ...easure is found an abundance of limonite (brown iron ore), ...ing metal of good quality. Galena and zinc are extensively ... near Aix-la-Chappele, and notably in the celebrated conces... the Vieille Montagne Company, where the whole mass of rock ...ermeated by zinc-blende, and is excavated in large open works, ... as by shafts. The coal measures overlie the Devonian rocks, ...up the two hollows. The southern, or Denant, basin is so ...ccupied by the Devonian rocks that the coal measures are but ...nted by two insignificant patches. The northern basin, on ...trary, is filled with an extraordinary number of beds of coal. ...ccupy the whole valley from Mons to Liege, watered by the ...

This coal district, having a length of about 100 miles, with ...rage breadth of eight or nine, is divided into two portions—...amur and the Liege coal fields. Having an immense number ...s, varying from a few inches to three or four feet in thickness, ...ality of the coal ranges through every shade from the brazil ...ack coal of South Staffordshire to the most bituminous. The ...res of the Liege basin are divided into three stages—upper, ...e, and lower. The lower, which extends through the whole ..., is composed of shales, semi-calcareous schists, and earthy ... known as *houille maigre*, *terre houille*, or simply *terrule*. There ...irty-three seams in this division; the coal contains iron py... and the poorer varieties are only used as house coal by the ... classes. The Middle measures, forming a belt in the eastern ...contain twenty-one beds. The coal is of a much better quality, ...ng very little ash, and containing only a small percentage of ...ur. The Upper measures comprise thirty-one seams, and oc... the high lands around Liege. These coals (houilles grasses) ...with great rapidity, insomuch that, in some instances, they are ... with earthy matter, to retard combustion. The western part ... coal basin contains a similar variety of beds. One peculiar ...f coal is found in the Mons district, known as the Flenu coal ...rns with considerable smoke and flame, and emits an intense ... The New Red Sandstone, so largely developed in Germany, ...cely represented in Belgium. To the east and west the coal ...es dip under the chalk, to emerge again eastward at Aix-la...le, and in the Westphalian coal field of Dusseldorf, and west... the coal outcrop near Boulogne. South of the great slate ...there are beds of bathstone and lias, traversed by veins of ...e, which, transported to the coal districts, is smelted into ex... iron. The cretaceous beds rest unconformably upon the ...They afford valuable material, as Fuller's earth, lime-chalk ...r, material for mending roads, &c. At Maestricht, famous ...ossils, there are immense chalk quarries, from which a con...e trade is carried on, chiefly along the Meuse. The whole ... north of Waterloo is covered with Tertiary deposits; and, ... Belgium shows the best development of modern strata. Like the London and Paris basins, these deposits form part of the great Tertiary plain of Europe, stretching from the Caspian Sea to the London basin. The various beds of this series are of small economic value, and are chiefly interesting in relation to agriculture, while the more recent deposits, from 3 ft. to 6 ft. thick, overlying a bed of turf from the Roman remains, which they enclose, yield their chief interest to the antiquarian.

COLLIERIES IN THE WIGAN DISTRICT.

The Moss Hall and Low Hall Collieries, near Wigan, comprise Nos. 1, 2, 3, 5, 6, 7, and 8 pits in use. The first five are in close proximity; Nos. 7 and 8 are situated at some distance from the others. Coal is raised from Nos. 2, 5, and 7 pits, to the extent of about 600 tons per day; this is obtained from mines in the Ince, Pemberton, and Wigan series, the lowest yet sunk to being the Wigan Nine-feet seam; 95 yards below that the Cannel and King coal are usually found in the district, and 200 yards deeper the Arley coal seam, all of which will probably be found in the property leased to the Moss Hall Coal Company.

No. 2 pit is a downcast, and coal is raised from the Pemberton Four-feet mine; its depth is 118 yards. The winding-engine has one horizontal cylinder. The pumping-engine is of a similar kind; it raises water from the Four-feet in two bucket-lifts. The Four-feet coal averages 4 ft. 6 in. thickness, is of excellent quality, and is brought from a downbrow underground, 1300 yards in length. The hauling-engine and boilers are placed near the bottom of No. 2 pit. No. 1 pit is appropriated solely as the upcast for No. 2 mine. No. 3 pit is now used only as the pump-shaft from the Pemberton Four-feet mine; its depth is 86 yards. A 22-in. beam-engine, 4½-ft. stroke, on second motion, raises water by means of two cranks, horizontal rods, and T-bobs, from the depth of 86 yards. There are two 12-in. bucket columns, both of which deliver at the surface. The engine goes usually six strokes per minute; it can be driven to 18 strokes. The winding-engine has a 20-in. horizontal cylinder, 4-ft. stroke, on second motion; it is now used only in connection with the pump work.

The principal plant is at Nos. 5 and 6 pits, which are about 40 yards apart. No. 6 is the downcast, 13 ft. diameter, not used at present for drawing coal; it is sunk to the Wigan Nine-feet seam. The winding-engine has two 28-in. horizontal cylinders, 6-ft. stroke, direct acting, double seat-valves, and foot-break; plain drum, 12 ft. in diameter, for round ropes; it was made at Haigh Foundry, in 1868. No. 5 pit is the upcast, 14 ft. in diameter, and from which the largest proportion of coal is drawn, from the Wigan seams. The winding-engine has two 30-in. horizontal cylinders, 6-ft. stroke, direct acting, double seat-valves. There are two drums for round ropes, one 17 ft. and one 19 ft. in diameter. The break-wheel between them is acted on by steam-power, and is 27 ft. in diameter; the drum is designed to be of the spiral form, and to wind from two levels, from the Four-feet and Nine-feet seams, instead of three levels, as at present. This will be effected by driving a tunnel from the Four-feet eastward to the Five-feet seam. Four tubs, or boxes, are raised in each cage, in two decks, each holding 6½ cwts. of coal. Each cage runs on three wire-rope guides. This engine is from the works of B. Hick and Son, Bolton. A 12-in. beam-engine at the top of No. 5 pit raises water in one lift of 40 yards up to the Pemberton Four-feet seam to No. 3 pumping-engine. The Wigan Five-feet seam lies here at the depth of 200 yards.

The section is—Metal, bad roof.

Top coal..............	1 ft.	0 in.	
Metal band	0	2	to 4 in.
Bottom coal...........	2	6	
Soft warrant.			

The dip of the measures is 1 in 7 to the east. The faces in the coal run north-west and south-east. The Wigan Four-feet seam averages 4 ft. in thickness, and is found at 237 yards in depth. The Nine-feet seam averages 6 ft. in thickness, and is found at 265 yards. The two lower seams produce gas more freely than the Five-feet. The workings are driven out on the same plan in each mine; the main levels from the pits are driven to the extremities, both north and south, and the jig-brows and subsidiary levels are being driven out in each case. In the Five-feet mine, which we inspected, the three main levels from the pit are 3 yards wide, 10-yard pillars between them; these are driven about 500 yards northward, and the same distance southward. The jig-brows to the rise or west are driven up 160 yards—in sets of three—200 yards apart, 3 yards wide, 10-yard pillars between. The middle place is for the incline, with double roads, two drums, 3 ft. in diameter, with wire-ropes, are used, eight tubs are run each way. Another brow is used also as an intake and travelling way, the third brow is the return. From the top of these brows levels are being driven, 3 yards wide, 10-yard pillars between them, in succession one above another, either north or south, up to the boundary. When this is done the pillars or walls will be removed southwards towards each main jig in succession downwards. It should be observed that holings are made between these levels every 30 yards, for which brattice is required. The roof and floor of the Five-feet seam are of a soft nature, and are stated to be unfit for building packing, and, consequently, the whole of the work in three directions is driven out strait; in the last process—removing the walls—the works are 10 yards wide. Neither in the Four-feet or the Nine-feet mines are the conditions considered as favourable for the adoption of wide work; in both the same system of strait work, as described, is being carried out. Lamps are used throughout all the mines. Powder is used in all for blasting the coal. In the Five-feet and Four-feet mines the shots are fired only by authorised persons during working hours. In the Nine-feet seam, where the explosion lately occurred, the shots are fired in the night by two men appointed for that purpose, none are fired during working hours.

The ventilation of the three mines is effected by a furnace in the Five-feet seam—7 ft. wide by 9 ft., and by another furnace in the Four-feet seam—9 ft. wide by 9 ft.

The air in circulation is	25,000	cubic feet per minute	in the Five-feet mine.
,, ,,	50,000	ditto	in the Four-feet mine.
,, ,,	50,000	ditto	in the Nine-feet mine.
Total	125,000		

As these mines become extended, it is in contemplation to increase the quantity for the whole to 250,000 cubic feet and upwards per minute. This is designed to be effected by making Nos. 5 and 6 pits both downcast, and by sinking No. 2 pit deeper to the Wigan seams, solely as an upcast, and of a large area. The question of mechanical ventilation will, no doubt, in this case be duly considered, and as fans are now largely used for the ventilation of mines, we may state that one of Guibal's fans, recently erected at the Earl of Lonsdale's colliery, near Whitehaven, is 36 ft. in diameter, and 12 ft. wide. The engine to drive it is 30 in. diameter, and 2½-ft. stroke. Experiments on May 10 last, gave with 72 revolutions per minute, a circulation of air in the mine of 182,000 cubic feet. The useful effect obtained from the fan was calculated to be 66 per cent., and the horse-power of the engine indicated 216. No details are furnished of the extent of the mine or the size of the air-ways, but 5 inches of water gauge seems exceptionally high. Duplicate engines and fans would obviate any danger that might arise from an interruption of the ventilation when only one is used; and at the depth of 260 yards the system of fans would be found much more economical in consumption of fuel than furnaces.

Horses are used only in the main levels in these mines. The roads are laid with bridge rails on a gauge of 20 inches.

Nos. 7 and 8 pits are about 40 yards apart, both are 12 ft. in diameter, and the winding-engines are placed between them. No. 8 pit is the downcast, and is now being sunk from the New mine, 100 yards, to the Pemberton Four-feet, which will be found about 200 yards in depth, and is intended to take the place of No. 2 pit for raising coal from the Pemberton mine. The winding-engine at No. 8 pit, now used for sinking, has two 16-in. horizontal cylinders, 3½-ft. stroke, direct-acting, one plain drum, 8 ft. in diameter, for round ropes. A larger engine will be substituted for this to raise the produce of the Four-feet mine. At No. 7 pit, an upcast, coal is raised from the Ince Four-feet mine, depth 60 yards. The winding engine has two 16-in. horizontal cylinders, 3-ft. stroke, direct-acting, plain drum for round ropes. These engines were made by W. Baker and Co., Wigan. At the bottom of No. 7 pit, a single horizontal engine placed in the New mine hauls from a downbrow in the Ince Four-feet seam, 100 yards in length. The Four-feet is obtained by a crossing a downthrow fault out of the New mine. The New mine will be got again by driving a tunnel 130 yards eastward, rising 2 inches per yard, from the Ince Four-feet seam. The same engine draws water in tanks up the brow; it forces water also to the top of No. 7 pit, through Four-inch mains, with a 5-inch ram. Steam is taken down the upcast pit in pipes to supply this engine. The working of the Ince Four-feet coal is conducted on the principle of strait work; but the New mine has been, and is intended to be got by long-wall work. We hope wherever wide work is practicable to see it preferred, as a matter of safety only. And a substitute for gunpowder will no doubt be found for our mines, the introduction of which recent events must greatly accelerate. The powers of the wedge and screw seem best adapted to the purpose of getting coal, but a concentration of power is required in a small space, otherwise the labour of drilling large holes for the insertion of any mechanical power is likely to prevent its general use.

Nearly the whole of the boilers at these collieries are of the plain cylindrical form, a few of them are double flued. The working pressure of steam is about 45 lbs.

COAL-CUTTING MACHINERY.

Sir,—I beg to offer a few remarks on this subject, which, as you justly observe, has thus far experienced much difficulty in being practically introduced; nevertheless, I consider the pick machine has so far established itself as to have the preference to any other which has since been brought out, and is at present the best machine in use for holing or kirving, so as to facilitate the getting of coal on the long wall system. In my opinion, the machine described in last week's Journal, called the "bow-saw," or even any other kind of saws, rubbers, or scrapers, on the so-called endless cutters, which you described a few weeks ago in the Journal, and which are neither more nor less than endless scrapers, which have been patented before, can ever, in a practical, suitable, and economical point of view, be maintained in preference to the clear and clean blow of the pick or cutter; there is too much rubbing surface for friction on the former, compared to the latter, therefore it can never be as effective with the same amount of power.

I have just finished the design of a re-arrangement of my cylinders, patented by me in April, 1868 (which arrangement is also covered by that patent), of a machine for coal-getting proper. The question of getting the coal down, after having been under-cut, even to the depth of 3 or 4 feet, except by the use of powder, and which is not considered safe, and in all probability will ultimately be prohibited, has become such an important one, that I have taken into consideration, combined with the machine, also the getting down of the coal, and to facilitate which I have arranged the machine in such a manner, so that when it has done its work there will be no difficulty in getting down the coal, or need for powder, nor do I anticipate there will be required a Jones's, Chubb's, or a Bidder's hydraulic apparatus, for that purpose.

The manner in which I propose, and have arranged, to accomplish this is as follows:—Instead of having a cylinder (mounted on the machine to drive the cutter) 6 or 8 in. diameter, to cut a groove at the foot of the coal 2 or 3 in. wide, and from 3 to 4 ft. deep, I have three or four small cylinders (according to the thickness of the coal), each about 3 in. diameter, driving its own cutter, cutting three or four horizontal grooves at the same time, each ¼ in. wide and 10 or 12 in. deep, and about 12 in. apart from each groove; each cylinder is also arranged to cut vertical cuts, from one horizontal cut upwards to the other, consequently, each cylinder having travelled 1 ft., a vertical groove will then be cut the whole thickness of the seam of coal; those vertical grooves I propose to make every 2 feet, the coal can then be readily pinched off by a sharp-pointed bar, each block of coal in the middle part of the seam being detached on all sides but one. The coal can be better separated where there is different kinds of coal in the same seam, as the cutters can be arranged to cut at any point the most suitable, and also to drive an ordinary heading. By this arrangement it will also be seen that the coal can be cut into any desired sized block, and prevents the possibility of being knocked to pieces after being got down, as is generally the case.

Waterloo Main Colliery, Leeds, June 20. J. Rothery.

MINING IN SHROPSHIRE—WEST STIPERSTONES MINE.

Sir,—"A Shareholder," writing in last week's Journal on this subject, laboured under a misapprehension. I made a survey of the property, and wrote the report which "Shareholder" quotes from, but I have never been the company's agent, consequently the shareholders have no just cause of grievance against me that weekly reports have not been published.

and still look upon them as a good investment. Taking for granted that "Shareholder" wrote not merely to complain, but to be informed of the progress made towards the accomplishment of the objects we all have in view—the development of the Roman and other well-known veins below the adit level, and the finding of a profitable mine—I beg to hand him the following particulars on the subject.

The engine-shaft, 10 feet long by 5 feet wide, started in the side of the hill, is nearly down to adit level, is well timbered and secured with sets cut out of pitch pine, and calculated for permanency; the sinking is being pushed on with a full staff of men, and it is calculated the shaft will be down to water line (when pumps will be required) by the time the water-wheel is in place for working. A cross-cut is being driven from adit east towards the said shaft, which, when communicated to that point, will facilitate the sinking below the level. It is intended to sink to a 10 fm. level, below adit, and then intersect the Roman vein, and lay open the ore ground known to exist upon it forthwith. With fair success this work will be performed in the course of the next six months. By driving upon the Roman the Bog and Pennerley lodes should be met with. The masons are busily engaged building wheel-pit, and as far as I can judge will complete their contract in about ten days from this date. The water-wheel (32 ft. diameter), with launders some 300 fms. long, is being prepared on the ground for erection, and will be got into place without delay. I may say, in conclusion, that the agent reports to the secretary as the general work progresses. ARTHUR WATERS.

Tankerville Mines, near Shrewsbury, June 21.

ON THE NATURE OF THE SILVER ORE RAISED AT THE QUEEN MINE, NEAR CALLINGTON, CORNWALL.

SIR,—It is often a difficult matter to determine with accuracy to what particular mineral species a silver ore belongs. To convince ourselves of this we have only to turn to Dana's concise description of the sulpho-antimoniates and sulpho-arseniates of silver, or of silver and lead, which, together with polybasite, silver fahlerz, sulphide of silver, and argentiferous galena, pass so gradually one into the other, and are so often found associated in the same lode. Moreover, the characters and composition of these various minerals are so similar that when no distinct crystals are to be discovered, and the specific gravity and blowpipe tests cannot enable us to distinguish them, nothing short of the most careful analysis will lead to their accurate determination. In the present case I had to choose between the following:—

Name.	Nature.	Spec. grav.	Silver p. cent.
Myargyrite	Sulpho-antimoniate of silver	5·2 to 5·4	36
Pyargyrite (ruby silver ore)	ditto	5·7 to 5·9	60
Stephanite (British silver ore)	ditto	6·2	70
Proustite (light-red silver ore)	Sulpho-arsenite of silver	5·5	64
Broyniardite	Sulpho-antimoniate of lead and silver	5·95	25
Freislebenite	ditto	6· to 6·4	22
Silver fahlerz	Sulpho-antimoniate & sulpho-arsenite of silver, zinc, copper, iron, &c.	4·5 to 5·1	0·2 to 31·
Polybasite	ditto	6·2	64 to 72

Fortunately, some of the samples sent for analysis to my laboratory from the Queen Mine, when first opened, were not pulverised, and I was thus enabled to satisfy myself which of these species were present. I soon discovered that there were certainly two distinct species in this ore. Among the specimens alluded to were two large stones, A and B, which I will describe in a few words:—

A.—Gangue of spathic iron, with a little quartz, and having a vein of silver ore the thickness of the little finger running through it. The pure mineral extracted from the gangue gave sulphur, antimony, and silver reactions below the blow-pipe. Specific gravity, 6·18, at 70° Fahr.; per cent. of silver, 69·14; trace only of copper; no lead; colour, black; metallic lustre; streak, black; sectile; fracture uneven; brittle; no distinct crystals. These characters are sufficient to determine the species as stephanite (brittle silver ore).

B.—Gangue of olive-green schist, with a little carbonate of iron, brilliant mass of silver ore in a lump, running into a fine string in another portion of the mineral. The pure mineral separated from the gangue gave before the blowpipe the reactions of antimony, sulphur, and silver; no lead; traces of copper; traces of prismatic crystals; colour, black metallic shining; streak, red (vivid); soft and sectile; per cent. of silver, 60; specific gravity, 5·78, at 73° Fahr. There is, therefore, no doubt in my mind that this is pyargyrite (ruby silver ore).

These are, at the present time, the two species of minerals which constitute the silver ore of the Queen Mine. A third specimen, composed of a thin metallic vein, about the thickness of a watch-glass, running through a gangue of spathic iron, quartz, and clay, appeared to consist of both species, for in some places it gave a red streak, and in others a black one. T. L. PHIPSON, Ph.D., F.C.S.,

Putney, S.W. Member of the Chemical Society of Paris.

THE METALS AND THEIR ORES—No. VI.

SPECTRUM ANALYSIS.

SIR,—Having, in the Journal of last week (in article No. V.), briefly explained the principle upon which the metals existing on the earth can be detected by spectrum analysis, I will now direct the attention of your readers to the manner in which the composition of the sun and planets, not only of our own system, but of the stars and nebulæ of the remotest systems from which light emanates, can be as perfectly ascertained as though these bodies were close at hand, and could be personally visited. It has been already observed that the spectrum from a flame of artificial light containing no metal does not produce either bright or dark bands or lines, while, on the other hand, if a metal is present in the flame, and if this metal be heated to volatilisation, bright bands perfectly characteristic of the metal will be distinctly and invariably seen in the spectrum, and so reliable and amazingly sensitive is this test that the presence of particles of matter much too small to be discriminated or even seen by the most powerful microscope may, by its agency, be clearly and accurately demonstrated; in fact, metallic substances, varying in quantity from the 1,000,000th to the 180,000,000th part of a grain may easily be recognised by spectrum analysis—a speck so minute that all other methods of analytical investigation would altogether fail in detecting it. So much, then, for the astounding means at command in spectrum analysis for the recognition of the metals existing on our own globe. In my last week's article I stated that the spectra produced by the sun, planets, and fixed stars give dark lines, and not bright ones. Let me now try to explain how these dark lines are produced, why they are dark instead of bright, and in what manner they can be applied to the purposes of solar and stellar research. From investigations undertaken by Prof. Kirchhoff it appears that an incandescent vapour or gas surrounding or covering a very luminous source of light absorbs those particular rays of light which it can itself emit—thus glowing atoms which vibrate to produce red light will intercept and absorb red light, atoms that vibrate blue will absorb blue, and so on with each colour. According to the same philosopher, the body of the sun is an orb of intense brilliancy, surrounded by a luminous incandescent atmosphere or photosphere, which envelopes the sun like a flame. The rays of white light proceeding from the central orb are intercepted or cut off by the sun's glowing atmosphere, which, however, at the same time, throws off the same rays of light that are absorbed by it, and the rays which are thus intercepted form gaps or dark spaces, containing relatively no light, and indicating those particular rays of sunlight which have been absorbed by the luminous atmosphere; therefore, if the sun's central orb did not exist, and a spectrum could be obtained from the sun's photosphere without it, each one of Fraunhofer's dark lines from such a spectrum would be reversed into a corresponding bright one. The dark lines are, therefore, produced by the passage of white light from the molten or solid surface of the sun through the incandescent vapour of the metals present in the sun's atmosphere. We have ascertained that a metal may be known by its characteristic bright bands, even though we may not see the metal itself—hence, if the sun contain any metals existing on the earth, the dark lines produced by them should exactly correspond with the bright lines produced by our terrestial metals, and by comparing these dark lines with the bright spectral ones, we are thus able to declare what metals are present or absent either in the sun or any other of the heavenly bodies—for example, sixty bright lines from the spectrum of iron perfectly correspond in uniformity and position with a similar number of dark lines from the solar spectrum, and, therefore, the presence of iron in the sun may be taken as satisfactorily proved. Prof. Kirchhoff has succeeded in detecting about nine metals in the sun's atmosphere—viz., iron, calcium, magnesium, sodium, chromium, barium, nickel, zinc, and copper. The metals gold, mercury, silver, tin, aluminium, lead, antimony, or arsenic have not as yet been detected. From the fact of the spectra of the nebulæ containing bright lines, and not, like the sun and stars, dark ones, it is reasonably inferred that the nebulæ are masses of glowing vapour or gas, and are not, as is the case with the sun and stars, composed of solid or molten matter enveloped in a luminous atmosphere. With reference to the fixed stars or suns of other systems, as the dark lines produced from their spectra do not uniformly correspond in position with those of the solar spectrum, it is more than probable that these bodies contain many metals not existing in the sun, and which are also unknown to us. In some of the stars, however, the metals iron, tellurium, sodium, magnesium, calcium, antimony, bismuth, and mercury have been detected by Profs. Miller and Huggins.

Upon a future occasion it is my intention to trace some analogy between the locked-up stores of light imprisoned for ages in the form of coal and the existence of the metals found on our earth. The sun's atmosphere unquestionably contains the vapours of many, if not all, of the metals known to us, and is it not possible for the invisible and infinitesimal atoms of these metals to have been transferred to our globe by the vibration of the waves of light? This may appear to be a somewhat startling theory, but comparatively we know little or nothing as yet as to what light, swift and imponderable though it be, really is, nor of the effects it is capable of producing. Truly may we exclaim with Hamlet—"There are more things in heaven and earth than are dreamt of in our philosophy." In my next paper I shall resume the description of "The Metals and their Ores." EDWARD GLEDHILL.

Mining Offices, Shrewsbury, June 20.

P.S.—The four new metals discovered by spectrum analysis are caesium, indium, rubidium, and thallium, *not*, as printed last week, calcium and irridium.

MINING IN COLORADO.

SIR,—The fine CASCADE LODE, supposed to be an extension of the celebrated Terrible, is situated on Sherman Mountain. The discovery shaft, 100 ft. deep, is east of and a trifle down hill from the line of the Terrible. The lode is opened by two shafts; the crevice is from 4 to 5 ft. wide, and the wall rocks well and clearly defined; the ore, which is argentiferous galena, zinc blende, and iron pyrites, varies in richness from $163 to $450 per ton. A quantity worked at Stewart's Reduction Works yielded $200 per ton (2000 lbs.) There is an average of 10 in. of ore at the bottom of the discovery shaft, some of which shows brittle silver.

Mr. Womack is working the deep shaft on the Womack and Seaton property No. 2 east; the shaft is 268 ft. deep, and is sunk on the dividing line between Nos. 2 and 3: 200 ft. below the surface men are drifting east, and another east drift has been started at the bottom. The crevice in the upper level is about 10 ft., carrying a 10-in. vein of first quality ore, averaging 100 ozs. of silver and from 2 to 2¼ ozs. of gold per American ton of 2000 lbs. There are now eight miners employed, who mine about 2 tons of first-class ore every 24 hours. Mr. Topping, who has charge of the work, promises to raise 20 tons of first-class ore per day, when the levels are run and stoping has commenced.

Major Latshaw is mining on the COPE LODE, near the head of Virginia Canon, with encouraging results.

Morilley and Anderson have been drifting in Payne's bar all winter, and making good wages. They lately struck it very rich, and now average an ounce to the hand per day. On Wednesday (May 4) two men took out 5 ozs. of gold, and the following day worked in dirt that averaged 15 dwts. to the pan.

A correspondent from Central City writes to us under date May 11—"When gulch miners are down on their knees in mud and water, washing fragments of a seamy bed rock, with woollen rags, and, despite such work, show a rare fund of good spirits, we always conclude that something is up. The fact is, Fitzpatrick and Sariolle have a pay streak that averages an ounce of gold to the foot, and have a great deal of ground to work. The week before last three men in six days took out 17 ozs. 10 dwts. of gold, and last week four men averaged nearly an ounce per day to the hand. I noticed a yeast-powder can that was used as a bank of special deposits for nuggets picked from the bed rock."

Mr. Wells, of the Smith and Parmelee Company, has a magnificent specimen from his mine, taken out at a depth of about 600 ft. Free gold, in crystallised form, in coarse lumps and wire gold, holding a cube of pyrites, closely resembling an ordinary gentleman's breast pin, found in breaking up the ore for the stamp mill. The mine has been sunk 90 ft. below the old levels, and a drift has been run of about 100 ft. east. The ore has steadily improved, and now just as Mr. Wells was expecting to commence a big business on his 100-ft. stope the water is likely to run him out.

About a mile above Donnieville, Col. O. C. Scovill has commenced to tunnel in Highland Mountain, for a company organised by him last winter. He has chosen a fine location, about 150 ft. down the hill from the Live Yankee lode. Some ten or fifteen lodes have already been located on the mountain above the tunnel. There is also some rich blossom, assaying over 1000 ozs. silver per ton, found in the hill, and which has led many to search for the lode, thus far without success. Contracts will be let for 50 ft. at a time, and the work will be pushed. If this tunnel succeeds as well as its nearest neighbour, the Morris tunnel, the Colonel and his company will get the credit of having a rich property.

The FAIRMOUNT LODE, in Hukill Gulch, has now a shaft 100 feet deep, showing a crevice at the bottom of 10 feet in width, and a pay vein averaging 30 inches. A contract has been let for a 200-feet drift west. The first-class ore from this mine is very rich in gold and copper, and some of it has sold for $150 per ton.

Mr. Baker is working the SHAFFTER LODE, in Hukill Gulch. Some very rich gold specimens have been taken from this mine. A test run of 5 to 6 tons of this ore, made at the Fairmount Arastra Mill, gave a yield of 2½ ozs. of gold to the American ton (2000 lbs.) W. C.

British and Colorado Mining Bureau, June 23.

THE WINTER'S FREEHOLD GOLD MINING COMPANY.

SIR,—A correspondent who, I suspect, is no shareholder, comments in last week's Journal upon the liabilities of this company, and expresses his opinion (like a kind Job's comforter that he is) that the company is in a state of bankruptcy. Several shareholders have written to me to know whether your correspondent is in possession of special information, as all the colonial papers—up to the date of the last mail's departure—speak in the most encouraging terms of our prospects. The *Melbourne Argus*, of April 23, says—"The recent discoveries in the mine have led the directors of the Winter's Freehold Gold Mining Company to expect very large gold returns before long, and acting on this expectation, they think they see their way clearly to pay off all their liabilities without being compelled to issue any more shares, and if their hopes be realised, the 5877 unsold shares will be written off, thus reducing the original number." The *Ballarat Star*, April 22, also says—"Winter's Freehold is looking promising; a golden wash has been struck, and is dipping westward." The manager of the company in the colony writes to me thus, under date of April 23—"The prospects of the mine are looking in every way encouraging. The debt is reduced by about 8000*l.* (within the quarter), besides providing a winter supply of fuel, erecting splendid puddling-machinery, and carrying on the necessary and extensive underground works. The whole of the calls have been paid up, notwithstanding the dulness of the market, and the great scarcity of money." A private note also acquaints me with the fact that most of the directors and the manager have lately increased their interests in the company. None of this looks much like bankruptcy. The local shareholders have paid up, on their own shares, in the three months, double the amount of capital raised in England altogether.

As for their debt, several companies surrounding us have had in the beginning debts approximately as large as our own, without possessing a single acre of freehold ground. The Winter's Freehold exceeds two square miles. The adjoining company and its next neighbour have before now paid dividends in a single month equivalent to the whole of our liability. A similar return, also, to what the Park Company (immediately to the north of the Winter's) has been giving from a single shaft would pay our debt off in four months. That the bank should advance such an amount shows the opinion the bank must have of the undertaking. In all probability dividends will be paid this year, sooner or later, and a very moderate return enable us to pay our shareholders 5 per cent. per month upon the capital invested. Should your correspondent be a shareholder it is not necessary to tell him that the fullest information can always be obtained freely upon application at this office. If he is not one I would advise him to invest at once, before the few shares now in my hands are withdrawn.

Royal Exchange Avenue. THOMAS DICKER, Resident Agent in London.

NORTH TRESKERBY MINE.

SIR,—The following bi-monthly sales of ore, extracted from the *Mining Journal* of the dates as given below, show the progress of this undertaking:—

		Tons	£	s.	d.
1869	July 31	126	584	0	0
	Oct. 2	196	898	0	0
	Nov. 27	198	983	0	0
1870	Jan. 29	255	1338	0	0
	March 26	270	1149	0	0
	June 4	288	1240	0	0

At the end of December last the average sales for preceding six months were 411*l.* per month, and price of shares 14*s.*, 15*s.*, and now the price of shares is 9*s.*, 10*s.*, with average monthly sales 621*l.* How is this explained?

June 21. OBSERVER.

APPEAL FOR THE WIDOW OF MR. RICHARD CORT.

HENRY CORT, the Father and Founder of the British Iron Trade, and the Tubal Cain of our Century and Country.—*Times*, July 26, 1856.

SIR,—In last week's *Mining Journal* I saw an advertisement under the above heading. Sorry, indeed, I was to read it, and deeply grieved to know that my late valued and much esteemed acquaintance, Richard Cort's widow, is so stricken down with sickness, is in such deep distress, and so much in need of pecuniary assistance. I remember well, in 1863, the late Richard Cort coming to me with a memorial to aid him in getting it signed by Members of Parliament for his pension, to be continued at his death to his widow. He was successful in getting about 50 influential M.P.'s to attach their names to it, and Sir James Elphinstone and other M.P.'s presented it to Lord Palmerston, who promised that "at Mr. Cort's death his widow, on her application, should have the pension continued, and pledged his successors by saying that any Prime Minister would be too happy to continue the pension to the widow for the great wealth that had accrued to the British nation upon Henry Cort's inventions." The promise of Lord Palmerston has been *vouched* by Sir James Elphinstone to Mr. Gladstone, but no pension has been yet granted Mrs. Cort.

Where are our brethren the ironmasters of Great Britain? one of whom, the late Mr. Crawshay, left seven millions of money, all accumulated from iron made by Henry Cort's inventions, &c.; and as this class of men are amongst our wealthiest manufacturers, including the Marquis of Bute, with an income of 320,000*l.* per annum, I urge, in mercy to the widow, and out of gratitude to the greatest public benefactor extant on behalf of the widow of the youngest son of that great inventor in iron, that our ironmasters do contribute to a fund that will bring this poor gentlewoman an income of 100*l.* per annum, and thereby prevent that great man's name from being recorded in a parish workhouse.

London, June 21. IRON FRAME.

[For remainder of Original Correspondence, see this day's Journal.]

COST-BOOK MINES, AND BANKER CREDITORS.

COURT OF THE STANNARIES.

His Honour the Vice-Warden of the Stannaries of Cornwall and Devon has just delivered the following important judgment:—

Re LEAWOOD MINING COMPANY (STANNARIES OF DEVON), re COMPANIES ACT, 1862.—In this case the Leawood Mining Company is under liquidation by order of this Court, and the Imperial Banking Company (Limited), a registered company, claims to be admitted to prove a debt of 99*l.* 8*s.* 4*d.*, as immediate creditors of the Leawood Mining Company, which is an unregistered company, commonly called a "Cost-book" company. Such companies are mere common-law companies, or partnerships, and do not usually profess to have powers to charge the members of them for money borrowed for the purpose of the working of the mine. The liability of the shareholders is commonly and *prima facie* considered to be pledged only to pay their agents the costs of working; and petitions to compel payment of such costs, actually incurred and audited, are part of the ordinary process of this Court, under the name of pursers' petitions, which seek to enforce payment by sale of so many shares of the defaulter as may suffice to cover the costs or calls in arrear; not by the way of forfeiture, but by way of lien on the shares. That the shares in such mining partnerships are not by implication made directly liable for loans obtained from bankers has been now settled so long, and by so many reported cases, familiar to this Court and its suitors, that I will only refer to "Ricketts *v.* Bennett," 4, Com. Bench, 686; and this applies, not only to a "Cost-book" company in Cornwall, or elsewhere, but to all other common-law partnerships to work a mine, except where the power to borrow is authorised by the original constitution of the company. *Prima facia*, a Cost-book company is, normally, carried on upon a "ready money principle." ("Lindley on Partnerships," 1, page 274; and also "Collier on Mines," pages 131–154; pages 115 and 116.) It is, I believe, contended that the special circumstances of this case warrant the banker in assuming that all the shareholders in this company either authorised the loans, or have so acquiesced in them as to put them in the position of immediate creditors of the company—*i. e.*, of each and every partner owning parts or shares in it. On the establishment of this company a set of special rules or regulations were signed by the first takers. This is now so common a practice, and resorted to with so little attention to the familiar principles of such mining companies, and so slender a knowledge of the general principles of the common law and of local usages, that I cannot help regretting that the term "Cost-book Principle" had not been at once dropped and discontinued in new unregistered companies. In some cases the new company more wisely confines itself to a general profession of the "Cost-book Principle, as recognised in the Stannary Court," and adds nothing more; but in the present instance, after setting out with a preliminary declaration that the mine is to be conducted "entirely on the Cost-book Principle," the rules proceed to add a series of 22 other rules, with little regard to any of the main attributes of such principle; but there is not among these any one that shows an intention to carry on the mine on the "banker's loan principle." There is, indeed, one (No. 22) which is a clause for making future alterations of the rules at special meetings convened for that purpose, but the books of the company show that no such special meetings were ever, in fact, held for such purpose; nor do I find among the seven or eight general meetings held during the continuance of the company, from April, 1864, to Feb. 26, 1867, that any resolution, directly or distinctly, recognised such loans. There do indeed appear in some of the accounts which were, or ought to have been, laid before the meetings, pretty strong symptoms of such dealings, but nothing amounting to a clear concurrence in the practice. The only loans which I find in books of the company appear to be founded on applications of Mr. Murchison, the secretary, for which he may be, and probably is, himself personally liable to the bank. It is singular that none of the circular notices issued before a meeting were produced before me, so that it does not appear to me that in such notices the attention of absent shareholders was drawn to the fact that there were any such loans, or that the members of the company were debited in the gross by the bank for such loans. The provision of rule 8, that makes a majority of the shareholders present competent to bind the whole body, may not be an improper one in itself, but it certainly has a tendency to narrow the governing powers of the partnership. Practically, it throws them into the hands of the two or three shareholders who are nearest at hand, and are the resident officers of the company. At two of the six general meetings I find only three persons present, and in one (on February 6, 1867) I find the secretary alone was present, and considered himself such a "majority" as to bind all the shareholders. No wonder, therefore, that we find him to be the usual applicant for assistance by way of loan or overdraft. (See Letter-book, pp. 179, 183, 253, 255.) Upon the whole, I feel myself unable to admit the personal claim of the bankers to stand in the position of direct creditors of the whole body of members. If the money is proved to have been actually expended on the works a legitimate claim of those managers or members of the company that borrowed the money may possibly entitle them to become, *pro tanto*, creditors of the company, subject, however, to any counter claim that may exist, as between them and the company, for calls. The bank will, of course, be at liberty to appeal against this judgment, and may, perhaps, reverse or vary it in such manner as the superior court shall think fit. I dismiss the claim, and confirm the previous decision of the registrar.—Costs reserved for consideration.

"WESTWARD BY RAIL."

The increasing interest felt in this country in all that relates to the Pacific States, in consequence of the large amount of British capital invested in the mines, will doubtless cause Mr. W. F. RAE'S "Westward by Rail"* to be read by a very large number of Englishmen, and as it is as amusing as it is replete with information, no one will regret an acquaintance with it. The author commences the account of his journey with his departure from Liverpool, accompanies his readers to San Francisco, and brings them home again to Euston-square, taking care to show them as much of the country they have travelled through as time will permit, and doing this in a kindly spirit, which contrasts most favourably with that we have been accustomed to notice in writers upon American subjects. The volume being devoted to the consideration of the domestic and general affairs of the people quite as much as to the affairs of a strictly business nature, there is, of course, less relating to technical mining than would be found in the report of a mineral surveyor, but the majority of readers will no doubt consider this to be rather an advantage than otherwise.

It has hitherto been a prevalent idea in England that "liberty, equality, fraternity" were so strictly adhered to in the States that but one class of railway carriage was known. Mr. Rae dispels this illusion, and teaches us that in fact, if not in name, there are first and second-class carriages differing more widely from each other than in England. About six years ago Mr. Pullman first constructed one of the cars which have made his name famous throughout the Union. Instead of confining himself at first to providing sleeping accommodation for night trains, he devised an arrangement which combined comfortable sleeping berths at night with luxurious seats by day. As much care was spent in decorating his cars as is expended in decorating the dwellings of the rich. The perfected car is a combined drawing-room, dining room, and bed-room combined. The cost of a single car exceeds 5000*l.* sterling. Mr. Rae tells us that the western railways, over which these cars were destined to run, had sometimes been constructed far too hastily to be smooth. In England, and in America also, the smoothness with which the train speeds along is in proportion to the care with which the rails have been laid, and to the completeness of the permanent way. The problem for Mr. Pullman was how to diminish jolting on rough roads. He solved the problem by giving more attention to the wheels and springs than engineers had given to the rails, joints, and sleepers. For a seat in one of "Pullman's Palace Cars" the passenger pays an extra fare, and

* "Westward by Rail: the New Route to the East." By W. F. RAE. London: Longmans, Green, and Co., Paternoster-row.

the extent to which they are patronised may be judged of by the fact that 1 per cent. per month is paid as dividend to the shareholders, while the reserve fund is increased by a like amount; and that the enterprise is equally profitable to the car company and to the railway company.

But mining matters are not altogether excluded from the book, an entire chapter being devoted to the description of the State of Nevada and its silver treasures, and in this connection he affords a useful hint to intending investors. Those who are on the spot may effect a profitable investment; those who are at a distance must trust to the representations of others; must rely upon the reports of assayers; must believe that the specimens shown to them really represent the character of the mines which they are asked to purchase. The following story, despite its exaggeration, is fraught with a useful moral:—"When new discoveries were being made daily the first duty was to get the specimens assayed. If the result were encouraging the claim would at once command a high price. One of these assays was too satisfactory. According to the assayer's report the proportion of silver in the stone was rather more per ton than if the whole had been solid silver, while it was added that gold to the value of $39 was also contained in it." Considering that the specimen assayed was a fragment of a grindstone, the effort of the assayer was terrific.

The perusal of Mr. Rae's book will do much to remove many false impressions which have been entertained in this country concerning the feelings of the American people, and the nature of American institutions. The work is spiritedly written throughout, and from the impress which it bears of being strictly impartial, of being, in fact, the work of a thorough Englishman, "fondly attached to his own country, and glorying in her renown, but who has had the advantage of traversing the greater portion of the magnificent continent of America, has enjoyed special opportunities for witnessing the working of the Government, and has profited by conversations with all sections and classes of its energetic and high-spirited inhabitants," it is entitled to the greatest praise, and should be carefully studied by all classes of readers, both in England and America.

TABULATED WEIGHTS OF IRON.—In calculating the weights of iron ships the advantage of a reliable set of tables to facilitate the work will be generally admitted; naval architects and shipbuilders will, therefore, be glad to learn that Mr. CHARLES H. JORDAN, M.I.N.A., has published a concise and valuable set of tables for their special use. The tables include weights for angle, T, bulb, round, square, and flat iron, and there is a very useful table of decimal equivalents of the divisions of a foot. The tables occupy but 16 small pages, and can, therefore, be conveniently carried in the pocket, yet they comprise all the information likely to be required.

The Royal School of Mines, Jermyn Street.

MR. WARINGTON SMYTH'S LECTURES.

[FROM NOTES BY OUR OWN REPORTER.]

LECTURE XLVI.—In reviewing the various apparatus employed for the purpose of winding the material up the shaft, we have hitherto looked at the elementary means of raising it—as, for instance, the windlass, worked by manual labour, or the pulley by horse power; and I have mentioned a few examples of the forms in which pulleys are placed on strong frames, and where they do good service, but which are not applicable to mines in which large quantities have to be raised, and where great speed has to be attained under the system which has now become indispensable to be employed, when we take the case of our larger mines and collieries into consideration. Colliery engineers of late years have to deal with pulleys and wheels of larger diameter, and machinery of a more powerful kind, than was formerly the case. When we see the great facility with which heavier weights are raised in our most extensive collieries, it is obvious that the arrangements must be of as perfect a character as possible. It was found out 20 years ago that the large cast-iron wheels then used where invested with many dangers as soon as a more rapid motion was given to them. Thus, when the weight came to a standstill the pulley continued to rotate, and did not stop, although the weight was brought to the pit bank. Several contrivances were introduced to meet this difficulty. To this end they attempted to lighten the apparatus by making rope of wire, and altering the pulley by putting in a small boss of cast-iron to receive the axle of the wheel, and making all the staves of wrought-iron, though the rim was continued of cast-iron. By these means the pulley was so lightened that wheels 16 ft. to 20 ft. in diameter were reduced to 3 or 4 tons in weight, considerably less than under the old system of all cast-iron. Water power is applied in various ways. First of all there is the simple methods used in the slate quarries and in collieries where there is a good supply of water, and where it can easily be got rid of after it has been used without the necessity of pumping it. Thus, if we have a shaft at the bottom of which is an adit, a system of water balances is adopted—a very cheap method indeed of applying water power. On a suitable frame over the shaft is placed a large pulley, from each side of which a rope or chain depends. To one end is attached the weight to be raised, together with an empty cistern, and to the other an empty cistern only, which, when filled with water, is heavier than the weight to be lifted. Supposing, then, that the empty cistern is at the bank, and the load at the pit bottom, the cistern is filled from a tank close by, and begins to descend, drawing up by its weight the kibblefull of mineral at the other extremity of the chain or rope. The descent is regulated by a strong brake, and when the water reaches the bottom it is released by the opening of a self-acting valve. Another load is placed over the emptied cistern, and that at the top having been filled, the action is reversed, and the water is introduced as before from the tank, and the weight on the opposite end raised. The great advantage of this plan depends upon the water running off without expense by an adit after being utilised, but I have seen in South Wales where it has been adopted, although the water has had to be pumped up again by an engine, and simply for the reason that a pumping-engine can be maintained at work at a cheaper rate than a winding-engine. It is obvious, however, that this method cannot be used except in shallow pits. Amongst other contrivances one of the oldest forms is that of the double bucketted wheel, much used in olden times in this country, and largely employed to this day on the Continent.

The construction of water-wheels has at various times undergone a good many changes, although the principle remains the same, and as it is a cheap power, and suitable for the purposes of slow winding, it may be well to look at some of them. At one time a double bucketted wheel was in use, the buckets being placed in opposite directions, so that when the action was reversed, and the stream turned on to the second arrangement of buckets, the drum was turned in the opposite direction. This is a powerful engine, but having to be built twice the ordinary width it is clumsy and heavy. Smeaton then introduced a single bucketted wheel, which was rendered as effective by the application of reversing gear made very strong. It acts by cutting off the supply of water, and a good deal of saving is effected and friction avoided. A mining engineer who goes abroad, say to Spain or to America, should thoroughly understand the construction of water-wheels, so that he may be able to direct the carpenter and smith how to do the work. This kind of wheel is in a great majority of cases between 3 and 4 ft. in diameter, while in some, especially favoured districts, they are as much as from 12 to 14 ft. Another form of wheel has a central boss of cast-iron, with arms and flanges of wrought-iron. The buckets are of wood, and shaped to fit the periphery of the wheel. A good deal of ingenuity has been bestowed upon the form and shape of buckets, and the best mode of placing them, so that they may acquire and communicate the greatest possible amount of power from the weight of water falling into them. Close calculations also have been made as to the incidence of the weight at different portions of the circumference of the wheel. So nicely and carefully have these matters been considered that by an ingenious contrivance the buckets are, as it were, ventilated so as to allow the escape of air driven into them by the water which, imprisoned in the bottom of the bucket, was supposed to lessen the combined force of the impact and weight of the water.

Amongst the various classes of water power that of the horizontal water-wheel, or turbine, has of late years been very considerably used. It has the advantage of occupying but a small space, and for its size is remarkably powerful. The water in this contrivance [of which a large model was exhibited] enters at the centre, and diverging from it in every direction, it then enters all the buckets simultaneously, and passes off at the extreme circumference of the wheel. The pressure with which the water acts on the buckets of the revolving wheel is in proportion to the vertical column of water, or height of the fall; and it is conducted into the buckets by fixed curved girders secured upon a platform within the circle of the revolving part of the machine. The efflux of the water is regulated by a hollow cylindrical sluice, to which stops are fixed, which act together between the guides, and are raised or lowered by screws that communicate with the governor, so that the opening of the sluice and stops may be enlarged or reduced in proportion as the velocity of the wheel requires to be accelerated or retarded. High-pressure turbines are particularly available in situations such as often occur in hilly districts, where high falls of water may be commanded, and the character of the site afford facilities for constructing tanks or reservoirs, so that a constant supply may be ensured. Low pressure turbines produce great effect with a head of only 9 inches, and are suitable for situations in which a large bulk of water flows with little fall. The applicability, therefore, of this invention to cases in which other power is difficult, and where it might be extremely awkward to put up an overshot wheel, has rendered its use on the Continent, and particularly in the Hartz, where M. Fourneyron's form of the turbine is the favourite. In this country the most notable application of the turbine is that at Laxey, in the Isle of Man, where there is one of large diameter at work.

As a rule water-wheels can only be used advantageously within certain moderate limits of velocity. It is obvious that if turned too fast there must be a loss of power as regards the effect produced by the weight of water. The proper speed for an overshot wheel is a rate of from 6 ft. to 9 ft. per second at the circumference, and the diameter, for similar reasons, should be limited to between 30 and 40 ft. The size generally of wheels used in mines varies as much as from 6 ft. to 70 ft. For the ordinary purposes of winding and pumping a diameter of something like 20 ft. is the most useful; if larger than that their working becomes expensive, and it is cheaper to have two wheels of moderate diameter than one larger one. There are, however, a few in England as much as 60 ft., and that diameter is exceeded by one used at the Laxey Mines, before alluded to.

Of late years, however, steam-power has been largely introduced into mining. The earliest pumping-engines were those of Boulton and Watt, and for a time their double-acting engines were so general that you might see them everywhere. They have been greatly improved from time to time, and many new kinds of engine have been tried. That now most popular is the Cornish engine, which is usually only single-acting—that is, the force of the steam acts only in one direction. One extremity of the beam carries a piston-rod, and the other a main rod, which goes down the shaft. The steam having acted for the down stroke, and the entrance-valve being closed, a communication is formed between the top and bottom of the cylinder by lifting a valve in the steam-passage, called an equilibrium valve; the pressures on the piston are thus equalised, and the weight acts to force the water up and raise the piston. It will be seen by the fine model of these direct-acting engines upstairs that the cylinder is placed in an upright position; but a very excellent kind of engine, and one much used, has two cylinders placed horizontally, by which a greater regularity of movement can be attained than can be secured by the single cylinder. [The Lecturer described at considerable length a variety of modes by which steam-power is applied, and the different forms which the better class of engines have taken.]

FOREIGN MINING AND METALLURGY.

It is estimated that in 1869 the French railway companies consumed 133,406 tons of iron rails, and 50,226 tons of steel rails, making a total of 183,631 tons. Foreign iron rails were also imported last year to the extent of 74 tons. The quantity of iron rails consumed in France during the ten years ending with 1869 inclusive, was as follows:—1860, 87,409 tons; 1861, 153,405 tons; 1862, 247,883 tons; 1863, 198,871 tons; 1864, 163,220 tons; 1865, 151,973 tons; 1866, 125,975 tons; 1867, 140,621 tons; 1868, 124,734 tons; and 1869, 133,480 tons. It will be seen that the consumption of iron rails—in consequence of the requirements of local or departmental railways—experienced a sensible increase last year in France, notwithstanding the increasing use which is being made of steel rails.

A petition has been recently addressed to the French Corps Legislatif by the Permanent League of Industrial and Commercial Liberty, represented by MM. Cail, Arles-Dufour, L. Say, Fould, Magne, sen., and other industrials, in order to obtain a suppression of the import duty imposed on coal entering France, which amounts to 1s. per ton. The petitioners, in support of their case, argue that very great savings would be secured to industry and commerce by the adoption of their ideas, while the Treasury would recover the temporary loss occasioned by the remission of the duty through the general stimulus which would be given to commerce. It is also contended that the reduction made in 1854 in the duty imposed on coal imported into France has not been attended with any disastrous consequences to French colliery owners, who have considerably increased their extraction since that year, and have continued to realise quite as large profits as formerly. The petitioners further represent that France will soon stand alone in taxing an article of primary necessity like coal, which is as indispensable to modern industry as bread is to the body. Thus, the attention of the Corps Legislatif is called to the fact that the United States seem disposed to relieve foreign coal from all taxation. Spain alone preserves a coal tax besides France, and even Spain has recently permitted English coal to be imported duty free. France, in the matter of coal imports, would thus seem to be less progressive than all other nations. As regards the condition of the Belgian coal trade, it may be said to be extremely favourable; everywhere there is great activity, the demand is sustained, and stocks are *nil*. Even qualities which had been neglected are again sought after, some rather important contracts having been renewed at an advance of 10d. per ton as from October next.

The condition of the Belgian iron trade continues favourable. Even merchant iron, although recently somewhat weak, has revived, and has been dealt in readily of late at 6*l*. 12s. per ton. The price of plates may be indicated as follows:—No. 2, 9*l*. 4s. per ton; No. 3, 10*l*. per ton; No. 4, 12*l*. 16s. per ton; and No. 5, 18*l*. per ton. Fresh orders do not flow in very freely, but various contracts for rails to be executed next year are in course of negociation. MM. Gillain and Co., of Châtelet, have just decided on blowing out one of their three blast-furnaces. The furnace to be extinguished is the oldest in the district, being in its twelfth year's working. It is intended, we believe, to replace this furnace by another of very large size. Several transactions have taken place of late in minerals of the Campina, at 4s. 6d. per ton on trucks. These minerals are regarded as good, especially for pig for the production of rails. Formerly the blast-furnaces of the Charleroi district consumed these minerals in considerable quantities, but latterly they have been somewhat neglected, now they are again coming into use. If Belgian ironmasters desire also to try Prussian minerals they can do it now, thanks to a new Belgian-Rhenish German tariff, applicable to the conveyance of iron minerals, manganese, and pyrites forwarded from stations on the Cologne and Giessen Railway to Belgium. A contract will be let at Brussels early next month for 3000 tons of Bessemer cast-steel Vignoles rails, with fish-plates, bolts, &c., as well as for 72 tons of iron cramps.

The tone of the trade in the Champagne (France) district has acquired increased firmness during the last few days. The demand is active for all articles generally, and the works are as busy as they well can be; unfortunately, drought has brought about a stoppage of operations in some cases. The establishments working with steam are putting forth all their productive power. We have no change to note in previous quotations; special iron is dealt in at 8*l*. 4s. to 8*l*. 12s. per ton for first class, according to quality; rolled iron for smiths' work has brought 10*l*. per ton. The iron trade has not experienced any very material change in the Franche-Comté district. There are not more charcoal-worked furnaces lighted than are actually required to supply the works which still consume charcoal-made pig, either partially or exclusively. The price of this pig, which had fallen several years since below the cost of production, is now firm at 6*l*. 4s. per ton, in warehouse at the producers. This price, although scarcely remunerative, cannot be increased, in consequence of the competition of Swedish iron and pig, and of the superior coke-made pig of the South of France. Decrees of Jan. 9, 1870, have brought about a more sustained and firmer sale for fine charcoal-made iron, and in consequence have again given confidence to those who apply themselves to the task of sustaining conscientiously the old reputation of the fine iron of the Comté group. The quantity produced, either of pig or fine charcoal-made iron, will not increase; but, at any rate, those who have resisted the deplorable trials of the last few years will survive. Upon the whole, there is more business doing, and more confidence in the future. There is no change to note in the Moselle group; orders maintain a regular current, and the works are largely provided with business. Refining pig has given rise to some rather important transactions, at 2*l*. 18s. per ton. As regards disposeable, quotations remain purely nominal, as the blast-furnaces have scarcely any stocks, while they have heavy engagements which they cannot execute quick enough to meet the wishes of their customers. One establishment in the Longwy group is mentioned as having sold 7000 tons in advance. Coke is hardening more and more in the Moselle; what was worth last year 14s. 6d. is now worth 16s. to 16s. 10d. per ton, and yet the qualities and quantities delivered are inferior.

Notwithstanding this scarcity of coke, new blast-furnaces of considerable capacity are being constructed every day. The Guise Works have increased the number of men employed to 2000; this increase of staff is occasioned by the numerous orders which the establishment has received, and which it is found difficult to execute. Affairs have been reviving at Paris, and prices of iron are sustained with firmness; puddled charcoal-made iron has made 9*l*. 12s. to 9*l*. 16s.

At Aulnoye, in Belgium, a profitable use has been found for the slag from the large iron works there. It is cast into slabs for pavement and paving purposes generally; into garden rollers and posts and pillars; and in some of its forms is described as artificial porphyry.

FOREIGN MINES.

ANGLO-ARGENTINE.—Captain Joseph Vivian reports for April—South Mines Capitan: The engine-shaft is now down from surface 32 fms.; no change in the ground since last reported on. The cross-cut driving east of the engine-shaft in the 20 fm. level, towards the main lode, is in 3 fms. 3 ft.: this end is in clay-slate.—Main Lode: The adit level is driven north of the cross-cut 6 ft., a level is also driven south of the cross-cut 7 ft., the lode in both levels is looking fully as well as when last reported on the 9th instant—a very fine-looking lode; in driving these levels we are only carrying about 5 ft. of the lode in width, leaving about 20 ft. in width for stoping, when required by the stamps.—Manager: The cross-cut driving in the base of the hill is extended 27 fms. The end is still in limestone.—Director: The cross-cut driving in the base of the hill towards the main lode is now in 7 fms.—North Mine Colonel: The engine-shaft is sunk from surface 19 fms. 3 ft.; we intend to sink 3 ft. more, and then cut a plat.—Surface Works: The house for the goverment are finished, and the yard will be completed next week.—Machinery: The engineers are making good progress with the boilers for the stamping-engine. All the other works are going on well.

ANGLO-ITALIAN.—Mr. Ferdinand Dietzsch reports for May: "On the whole, the prospects of the gold mines are not so favourable as I should wish. Most of the lodes are small, and afford ore intimately intermixed with poor material, a circumstance which renders results not consistent with former trials by assay of small samples.—Reduction Department: The total amount of ore treated since the starting of the stamping mill to end of May is 124 tons during 16 average working days. The average contents of the ore are much below what I expected, and the concentrated sand extremely refractory in amalgamation, the gold scarcely unites with the mercury. An experiment with the view of neutralising the effect of the noxious matter failed, and it is for this reason not much gold is ready for remittance. The small ingot in hand weighs 7 ozs. 11 dwts. This is not the entire produce of the ore treated; there remains still to be extracted, as amalgamation failed by washing and concentrating process, 1¾ ton of concentrated sand, containing at a low estimate 7 ozs. of gold." Referring to the new mineral discovery of last month, Mr. Dietzsch writes:—"Our demand for the Government permit is having its regular course, and I think we may expect a speedier decision than anticipated. My journey to the German mines and establishments had as a result a good deal of information about the mineral, its value and mode of preparation for commerce. There has not been sufficient time to make experiments with ours, but all authorities on the matter agree that it is marketable; in fact, I have seen mines disposing of material for foreign markets much inferior to that found here, at a price which would render the working of ours profitable. This, to be brought into commerce in the most profitable way, requires some preparation by washing and concentration, and I would propose making, as soon as possible, some temporary inexpensive arrangement to prepare 10 or 20 tons for the English market as a trial."

PACIFIC.—Capt. Brown, Lander Hill, May 27: I have much pleasure in informing you that the lode in the 400 ft. level still continues good, about the same value as when last reported on, worth 200*l*. per fathom; and from its appearance I think we shall open up a good mine in our western ground. About the latter part of next week, if possible, I shall open out stopes in the back of this level. I hope to take out a good crushing of ore. In the 550 ft. level south the ground is a little softer for driving, and letting out more water. I regard this as a very favourable indication of nearing a branch or lode. No change to notice in our 550 ft. level north-west. I am pushing on every point of operation as fast as possible.

MONTE ALBO.—The agent in Sardinia reports that 300 tons of dressed ore is now lying a Siniscola, awaiting shipment, and that he has chartered a ship from Genoa to take the ore to the Tyne. Samples of this ore have been assayed and valued at 14*l*. a ton, ex ship in the Tyne. He adds that 1000 tons will be ready for shipment by end of July.

EXCHEQUER.—Capt. Chalmers, May 23: During the week ending Saturday, May 21, the air-shaft was raised 10 feet by one shift, the other being employed in timbering about 40 ft. of caving ground in the tunnel. The north drift in the winze was in 16 ft. The additional size of our new windlass necessitates an enlargement of the hoisting chamber, which is now being proceeded with; this will, of course, retard, *pro tem.*, the work below.

[For remainder of Foreign Mines see to-day's Journal.]

MINING, METALS, AND MINERALS—PATENT MATTERS.

BY MICHAEL HENRY,
Patent Agent and Adviser, Memb. Soc. Arts, Assoc. Soc. Eng.

Mr. J. BUCHANAN, of Gateshead-on-Tyne, has obtained a patent for apparatus for coiling electric telegraph cables or ropes. To carry out this invention a frame is employed, capable of revolving about an upright axis or post in the centre of the coil, and having an arm capable of sliding in and out to and from the centre. The cable or rope to be coiled passes down a tube in the centre of the frame, and is led to a roller at the outer end of the arm. The frame is caused to revolve by manual labour or by power, and the roller at its end, as it travels round, lays the cable or rope in a close spiral, from the centre of the coil to the circumference, and then back again in a second layer from the circumference to the centre, and so on. The arm receives its in and out motion by means of pegs or teeth upon it gearing with a pinion, which works as in a mangle motion, first along one side and then along the other side of the row of pegs or teeth, thus reversing the motion of the arm each time that the end of the row of pegs or teeth comes up to the pinion. The pinion is driven by a wheel upon its axis gearing with a wheel on the central axis or post, which remains stationary whilst the frame revolves. The frame is supported on three or other number of conical rollers, which rest on the coil, and, consequently, the frame with the gearing and parts in connection therewith rises as the coil accumulates, whilst at the same time the weight on the rollers serves to render the coil compact, and to prevent any of its convolutions rising after they have been laid. The method of actuating the arm may be varied—for example, a double-threaded screw may be substituted for the mangle motion, but the latter has this advantage, that the travel of the arm can very readily be altered as the circumstances of each case may require. In either case the frame revolving around a central axis or post, and supported by rollers resting on the top of the coil, and the arm moving in and out to and from the centre are employed. In some cases the frame is made reversible on the central axis or post, in order that the apparatus may work with less headway than would otherwise be requisite. This allows the gear, which is necessarily above the coiling surface when the operation commences, to be inverted, and to work in the eye of the coil as soon as the height of the coil admits. The same apparatus may be used in uncoiling or paying out the cable or rope. The cable or rope, as it rises, then gives motion to the arm and frame in the direction opposite to that of coiling, and the apparatus will effectually prevent two convolutions of the coil from rising together.

Messrs. W. A. MARTIN and E. WYLAM, of Fleet-street, have obtained a joint patent for an invention relating to fuel-feeding and smoke-consuming apparatus for furnaces. The object of this invention is the feeding of the fuel to furnaces in such manner as to ensure the consuming of the smoke arising from the combustion of the fuel. This is effected by providing the aperture through which the fuel is fed with a frame fitting therein or thereto. The bottom part of this frame consists of a bed-plate, while the two sides, which project externally, form two angular flanges. The largest or broadest portion of these flanges is at the top, and they diminish as they approach the bed-plate. A plate fixed upon the edges of these flanges, and extending from one to the other, forms with the flanges a hopper for the reception of the fuel. Upon the bed-plate, which by preference is fixed at an angle, so as to dip downwards towards the interior of the furnace, is placed a sliding-piece, or "rammer." This rammer has beneath at each side a rack, and into these racks are geared pinions, keyed on a shaft, the bearings of which shaft are on the under side of the bed-plate. The rammer forms a moveable bottom to the hopper, and can be moved inwards or outwards by means of the shaft-rack and pinions, the side flanges of the frame being so formed or placed as to serve as guides.

MANUFACTURE OF COPPER, &c.

Mr. JAMES B. ELKINGTON, of Newhall-street, Birmingham, has just specified his invention for improvements in the manufacture of copper, and in separating other metals therefrom. Mr. Elkington says—

For this purpose I smelt the copper ore so far as to obtain an impure metal therefrom, which I then cast into plates, and by means of electricity I dissolve these plates, and deposit the pure copper on to other plates. The other metals with which the copper is combined fall for the most part to the bottom of the vessel in which I operate. This process in its general outline, as above stated, is not new, for it has before been patented and used by me (see patent dated Nov. 3, 1865, No. 2838).

My present invention consists in improvements in the method of conducting this process. I prefer to employ copper ores which contain sufficient silver materially to injure the copper if smelted in the ordinary way, and which consequently would usually be submitted to process for extracting the silver before they are smelted. In such ores frequently the quantity of silver is not such as to pay for the cost of extraction, but the process has, nevertheless, been necessary when copper of high quality is required to prevent injury to the copper. These ores are particularly suitable for my use, as the silver they contain, which does not raise their price in the market, is recovered by me without any additional cost. Ores containing a larger quantity of silver, say from 8 ozs. to the ton and upwards, and which are now always submitted to a process for extracting the silver before they are smelted, can also be advantageously worked by my process, as can also ores containing little or no silver; but in this latter case the advantage of my process over the ordinary process is mainly in the better quality of copper which I obtain. I smelt the ore in the usual way, so as to obtain all its metallic contents (except such as may be volatile) in the form of regulus, from which stage by preference, but it is not essential, I carry the metal on to the state of pimple or blister copper. This impure metal I cast into plates (say) 24 in. long, 8 in. wide, and 1 in. thick. One end of the plate is provided at the centre with a stout T-shaped head of wrought-copper; it is placed in the mould in which the plate is cast. Cast-iron moulds are used; the metal is tapped out of the furnace on to the sand-floor, and is led by channels into the moulds. The plates thus cast are ready to go to the dissolving-house, which is laid with a wooden floor, inclined from end to end ½ in. to 1 foot. The boards are grooved on their edges, and small strips or tongues of wood are inserted into the grooves, so that there can be no open joints, and the surface is thoroughly saturated and covered with pitch to make it water-tight. The surface of the floor is divided into a number of troughs running from end to end of the building by ledges of wood fixed down upon it; these are also saturated with pitch. Each trough is of a width to receive three stoneware jars side by side. The jars are cylindrical, 34 in. high and 18 in. wide. There are pathways between the troughs for the workmen who attend to the process. Each trough is filled from end to end with jars; there may be (say) about 100 jars in each trough, and 12 troughs in the width of the building. The jars should be of fire-clay ware, so that they may not be injured by the solution which they receive; each has a hole in the bottom closed by a wooden plug, also a hole in the side 4 in. from the bottom, and another hole diametrically opposite to the first and 4 in. from the top. The jars are set up level on the inclined floor with wooden wedges saturated with pitch. The jars are connected together from the upper to the lower end of the room, each jar having a pipe passing out from it at the hole near the top, and entering the next jar below at the hole near the bottom. The connections with the jars are made with vulcanised India-rubber, and intermediate of the connections the pipes may be of lead, and about ½ in. internal diameter. The solution which I employ is water, charged with as much sulphate of copper as it will dissolve. The sulphate of copper of commerce may be used, or for economy I sometimes use a solution obtained by boiling the deposit found in the culvert or long flue by which the smoke from the copper furnaces is led to the high chimney; this will furnish a solution of sulphate of copper sufficiently pure for the purpose. The solution is stored in a tank at the upper end of the dissolving room; it is admitted into the uppermost jars, and runs from jar to jar until those at the lower end of the building are filled. Clips are put upon the India-rubber connections to stop the flow through the tubes when the jars are full, and so to maintain the solution at the proper level in the upper jars. When the process is in operation two clips are taken off (say) once in 24 hours, so as to cause the solution to flow through all the jars and transfer the solution from the bottom of one jar to the top of the next, so as thoroughly to mix it, as in working it tends to become weak at the top of the jar. This means of readily equalising the density of the solution is of great practical importance. At the lower end of the room is a tank to receive the solution; when it is thus allowed to run through it is pumped back into the upper reservoir. The same receives the contents of the jars when they are emptied on to the floor beneath by the removal of the bottom plug, as hereinafter described. In the gangways between the floor troughs a truck runs to carry the cast copper plates to the jars in which they are to be dissolved. Six metal plates are suspended in each jar; they are hung in couples from the horizontal copper bars, having forks upon them to receive the T-formed heads of the plates. These bars rest at their ends on other bars of wood laid on the jars so as each to extend across a row of three jars, and the same bars also support over each jar two other metal cross bars to support plates to receive the deposit of copper from the solution. There are two receiving plates in a jar, two suspended from each bar; they are interposed between the cast plates. Conducting strips of sheet copper are laid upon the wooden bars so as to couple the cast plates of one jar to the receiving plates of the next jar, and so throughout the series of (say) 100 jars. Each metal cross-bar is made to bear on a connecting strip at one end, at the other on a wooden block saturated with pitch. The jars are each provided with a false bottom of wood to prevent breakage of the jar in case a plate should fall. The receiving plates may be of wrought-copper, but I prefer to employ in the first instance gutta percha coated with bronze powder; as soon as a deposition

of copper is obtained the gutta percha is stript off, and the copper left to receive a further deposit. A series of (say) 00 jars being thus coupled up into a circuit, I connect to the terminals of the series one or more electro-magnetic machines. I prefer to employ the machines manufactured by Messrs. H. Wilde and Co., of Manchester. The machines called by the makers 3½-in. machines are those which I use, and I drive them at 2500 revolutions per minute. With three such machines working into a series of 100 jars a deposition of 4 or 5 lbs. of copper in each jar may be obtained in 24 hours without injury to the solution. When the cast plates become so far dissolved as to be unfit for further use they are removed; their remains are washed in the lower solution tank to remove the deposit from their surfaces, and they are melted and re-cast. The wrought T-heads may be used an indefinite number of times, as I protect them from solution by coating their stems with wax. The receiving plates are allowed to grow until they attain a convenient weight; they may either be melted and cast into cakes and afterwards rolled in the usual way of working copper, or the plates as they come from the vats may be sent into the market. The solution may be woked for a very long time, evaporation being supplied by the addition of water acidulated slightly with sulphuric acid ultimately will become so charged with sulphate of iron as to make it inconvenient to work it further. If, however, the metal be advanced to the pimple or blister stage before casting the plates it will take but little iron into the solution. The silver or other metals (excepting the iron) with which the copper of the cast plates was contaminated sinks to the bottom of the jars, and is there allowed to accumulate until it reaches the lower side hole; when this happens the bottom plugs are taken out of all the jars of the series, and the contents washed out into the floor trough, which discharges them into the tank at the end of the building; here they settle from time to time, the tank is pumped dry, and the sediment is taken out. There are two such tanks at the lower end of the room to allow of one being put out of use for emptying. The sediment may be treated in any ordinary and well-kown manner for the recovery of the silver it contains, and other metals may be separated from it should it be considered desirable to do so.

IMPROVED MODE OF TREATING METALLIC ORES, &c.

Mr. CHAS. CROCKFORD, of Holywell, Flintshire, has just specified his invention for improved modes of treating metallic ores and materials, and obtaining metallic and chemical products therefrom, and for utilising some of the waste products from smelting works, chemical works, tin-plate works, galvanising works, and paper mills, and for improvements in furnaces and apparatus in carrying out the same. Mr. Crockford says—

The first part of my invention consists in the mode of treating the ores of lead or materials containing lead, and I proceed as follows:—When the ore or materials contain sulphide or oxide or carbonate of lead or metallic lead I treat it with hydrochloric acid, using sufficient to convert the whole of the lead into chloride of lead; and, in the case of sulphide of lead, I perform the operation in a close vessel, either with or without the application of heat, and I collect and utilise the sulphuretted hydrogen generated during the process. If the material contains sulphate of lead I add a sufficient quantity of chloride of sodium or magnesium to convert the lead into chloride of lead, and in whatever state the lead may be in any of the materials which I may operate upon I first convert it into chloride of lead. I then dissolve out the chloride of lead with a strong solution (hot or cold) of chloride of calcium, strontium, potassium, barium, magnesium, or manganese, and I precipitate the lead from this solution by any known reagent, or I precipitate it by galvanic action, in which case I collect and utilise the chlorine given off during the process. When the mineral or material contains silver this metal may be precipitated from the solution before the lead by means of metallic lead or copper. In the case of the sulphate of lead, instead of first converting it into chloride of lead I prefer at once to treat it with a strong solution of earthy chloride, which converts it and disolves it at the same time.

The second part of my invention consists in treating materials or minerals containing lead, silver, zinc, copper, iron, or other metals, or any of of them; the process which I am now going to describe being more particularly applicable to the treatment of the mineral known as bluestone, which is obtained from the island of Anglesey. I proceed as follows:—I first calcine the mineral and collect and utilise the sulphur driven off in the manufacture of sulphuric acid, or I calcine it at a very low heat, so as to convert the greater part of the metals into sulphates. I complete the conversion of the metals into sulphates by the addition of sulphuric acid. I then wash out the soluble sulphates with water, and first precipitate the copper by any known reagent. I then precipitate the iron, if there be any in the solution, with caustic magnesia, and, having separated the precipitate from the liquor, I then precipitate the zinc by the addition of more caustic magnesia, and having again separated the precipitate from the liquor, I boil down the latter and crystallise it as sulphate of magnesia. I dry and calcine the precipitated oxide of zinc, and it may then be used for spelter making. Instead of precipitating the zinc from the solution I prefer in some cases to boil the sulphate of zinc to dryness, and I mix the carbonate or caustic magnesia with it. I submit the mixture to the action of heat in a reverberatory or other furnace, by which the interchange is effected, and I afterwards wash out the sulphate of magnesia. The undissolved residue of the mineral or material containing sulphate of lead and silver I treat in the manner described in the first part of my present specification. Instead of precipitating the zinc with carbonate of magnesia or caustic magnesia, I prefer in some cases to precipitate it with ammonia, distilled from gas liquor, in which case I produce oxide of zinc intermixed with sulphide of zinc and also sulphate of ammonia. Or, instead of dissolving the bluestone or like material in sulphuric acid and converting the metals into sulphates, I prefer sometimes to dissolve the roasted mineral or material in hydrochloric acid and precipitate the zinc with ammonia from gas liquor, thus producing oxide and sulphide of zinc and hydrochlorate of ammonia.

The third part of my invention consists in treating the waste liquors from tin-plate works and iron galvanising works consisting of sulphate and chloride of iron, and these I treat with ammonia from the gas liquor, and produce oxide and sulphide of iron and sulphate or hydrochlorate of ammonia.

The fourth part of my invention consists in treating the material known as flux skimmings produced in the process of galvanising or coating iron with zinc. For this purpose I add a sufficient quantity of hydrochloric or sulphuric acid to the flux skimmings to disolve all the zinc, and then precipitate the zinc with the ammoniacal gas arising from the distillation of gas liquor, by which means I obtain oxide and sulphide of zinc and hydrochlorate or sulphate of ammonia. Sometimes I pass through the solution towards the end of the operation a stream of sulphuretted hydrogen, for the purpose of rendering the precipitation quite complete.

The fifth part of my invention consists in treating the liquor from paper mills, resulting from boiling "esparto grass," wood, or other material in caustic soda. I first evaporate the liquor to dryness, and I then submit the dry product to distillation at a red-heat, whereby I am able to collect the volatile resinous and other matters, and I afterwards extract the carbonate of soda left in the furnace or retort in which the distillation has been effected by lixiviation, and at the same time I am able to extract a quantity of black, similar to "lamp black."

The sixth part of my invention consists in condensing and collecting fumes from smelting-works. I draw off the mixed fumes and gases from the flues of furnaces wherein lead or other metal is smelted, and force them by means of a fan or other similar means into and through a quantity of filtering material, such as canvas, cotton, or fine coke, which material I may renew from time to time when it becomes clogged, and I prefer before passing the fumes and gases through the said material to cool them by passing them through showers of water or otherwise, and I am thus able to use materials which would otherwise be destroyed by the heat.

PURIFYING IRON.—The invention of Mr. A. BRADY, of Stratford, consists in mingling, mixing, and manipulating sulphates of soda, potassa, and alumina, or any sulphates of the metals of the alkalies, earths, or alkaline earths and calcium, or the oxides, or other compounds thereof, with any sort, kind, or description of melted iron ores or iron pyrites, or of any other melted metal or mineral in an ordinary blast-furnace by common mechanical means, or the melted iron can be poured on to the sulphates in suitable vessels, but the calcia should be added last, the chemical changes and results consequent thereupon decomposing, evolving, separating, combining, and depositing by the laws of natural chemical affinity the impurities of carbon, phosphorus, silicon, sulphur, and generating sulphurous acid gases, and forming a slag.

OBTAINING BLAST FOR SMELTING-FURNACES.—By the invention of Mr. C. H. HOLT, Manchester, steam is applied so as to escape in an annular form into the passage for the supply of the air, which will thereby be drawn in and caused to flow within and around the annular jet of steam. There may be also a central jet of steam to aid the current, and there may be two or more annular rings of steam flowing in the same direction, but one in advance of the other, with the air passing within aud around each. Instead of injecting directly into the tuyere-holes, the inventor may, in some cases, inject first into a separate vessel, and, if necessary, he employs a jet of water to condense the steam flowing through these jets. The water thus obtained may be run off by a syphon or other suitable apparatus, so as to prevent the air escaping in that direction.

MINERS' SAFETY-LAMP.—The invention of Mr. E. THOMAS, Aberdare, consists, first, in so constructing the lamp that the air which is required for the purposes of combustion is admitted through openings in a perforated ring near the top of the lamp, and passes down to the wick or flame through wire-gauze. Second, in fitting the glasses of the lamp perfectly air-tight by means of elastic and metallic substances placed at the top of the glasses.

SAFETY-LAMP.—By the invention of Mr. T. A. DILLON, Dublin, a strong case, of convenient portable size, is constructed of any suitable material, such as metal, wood, glass, vulcanite, or ebonite, or of a combination of such materials, openings therein being provided, which are fitted with glass (when the outer case is not of glass), by preference of a lenticular form, and through which the rings of light from the flame of the lamp are transmitted. In this outer case is placed an inner water-tight lamp, constructed of any material or materials adapted to the purpose, and formed with openings, which are also fitted with glass, by preference of a lenticular or other form, when the said inner lamp is not constructed of glass (as it may be), and which correspond in position with the openings in the outer case. The upper portion of the inner lamp is constructed in the form of a double cone, the space between the outer and the inner cones serving as an inlet passage for the admission of air or oxygen, or a mixture thereof, for the purpose of suporting combustion and generating light (when sources of light are used requiring a supply of air or oxygen) whilst the inner cone carries off the products of combustion.

ELECTRO-CATHODIC INSULATING MASTIC.—Mr. J. CROUZIERES, Ollioules, France, has invented a new composition for preserving metal. Take of sulphur, (say) 38 per cent.; coal tar, 20 per cent.; gutta percha, 5 per cent.; minium, or red lead, 6 per cent.; white lead, 7 per cent.; pitch, 10 per cent.; resin, 10 per cent.; spirit of turpentine, 4 per cent.: total, 100. Melt the sulphur in one vessel, and coal tar, gutta percha, minium, white lead, pitch, and resin, all together, in another, but before adding the gutta percha to the coal tar, dissolve it, as far as possible, in the spirit turpentine, and when all these ingredients have melted pour in the sulphur very gently from the separate vessel, then thoroughly mix the whole, and apply the composition hot by the aid of a brush by dipping the article to be coated into it, or in any convenient manner,

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